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United States Government Accountability Office
Washington, DC 20548

December 16, 2010

Congressional Committees

Subject: *Defense Management: DOD Needs to Monitor and Assess Corrective Actions Resulting from Its Corrosion Study of the F-35 Joint Strike Fighter*

This report responds to House Report 111-166 to accompany the House bill (H.R. 2647) that later became the National Defense Authorization Act for Fiscal Year 2010.[1] The House Report noted the House Armed Services Committee's concerns that the lessons learned regarding the prevention and management of corrosion in the F-22 Raptor had not been fully applied to the development and acquisition of the F-35 Joint Strike Fighter. The House Report directed that the Director of Corrosion Policy and Oversight evaluate the F-35 program and submit a report to the defense committees within 180 days after the act was enacted. The Department of Defense (DOD) report was also to include implications for existing and future weapon systems based on the findings of the F-35 evaluation. DOD submitted its report to Congress in September 2010.

House Report 111-166 also directed the Comptroller General to provide an assessment of the completeness of DOD's evaluation and submit a report to the defense committees within 60 days after the date on which DOD submits its evaluation. In assessing the completeness of DOD's corrosion study, our objectives were to determine the extent to which the study (1) assessed the incorporation of lessons learned from the F-22's corrosion problems into the F-35's corrosion prevention and control (CPC) program, (2) identified implications for other current and future weapon systems' CPC programs, and (3) was consistent with generally accepted research standards that define a sound and complete study with regard to design, execution, and presentation.

To conduct this work, we reviewed DOD's September 2010 report and documentation that the DOD study team collected. We interviewed members of the DOD study team to obtain their views on key aspects of the evaluation, and obtained the perspectives of the Air Force and the Navy corrosion executives and F-35 and F-22 program offices on DOD's study. We also identified generally accepted research standards, based on prior GAO work, which define a sound and complete study, determined which of these standards were relevant to DOD's corrosion study, and compared characteristics of DOD's study against those standards.

We conducted this performance audit from July 2010 to December 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

[1]Pub. L. No. 111-84 (2009).

Report Documentation Page

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On November 15, 2010, we provided a draft of this product to the defense committees. Our evaluation of DOD's corrosion study is discussed in the attached briefing slides (see enc. I). In summary, DOD's study identifies several areas where the F-35 program has incorporated lessons learned from the F-22's corrosion problems, compares and contrasts the two aircraft programs, and discusses potential future corrosion issues for the F-35. The corrosion study also addresses various implications for other weapon systems' CPC programs. For example, it identifies key practices on which effective corrosion prevention and control for any weapon system depend, names five specific weapon system programs that could benefit from F-22 and F-35 lessons learned, and cites commonly noted corrosion prevention and control issues. The corrosion study was generally consistent with research standards that define a sound and complete study with regard to design, execution, and presentation.

Further, we found that the study team made recommendations in exit briefings to the F-35 and F-22 program offices and that the report contains numerous statements suggesting corrective actions may be needed at other weapon system program offices, the services, and DOD to improve their CPC programs. However, no formal recommendations were made in the report. In the absence of formal recommendations, it may be difficult for DOD and Congress to monitor and assess corrective actions resulting from the corrosion study. Following up on corrective actions would help DOD to minimize the impacts of corrosion on military equipment. Therefore, we are making recommendations that the Secretary of Defense direct the Under Secretary of Defense for Acquisition, Technology and Logistics to document, and establish a process for monitoring and assessing, corrective actions taken by the F-35 and F-22 program offices, other weapon system program offices, the Air Force, the Navy, and DOD in response to the corrosion study.

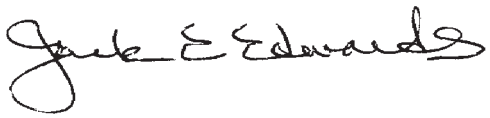
In commenting on a draft of this report, DOD concurred with three recommendations and partially concurred with one. DOD's written comments are reprinted (see enc. II). DOD also provided technical comments that we have incorporated into this report where applicable.

DOD concurred with our recommendations to document F-22 and F-35 program-specific, service-specific, and DOD-wide recommendations flowing from the corrosion study and to establish a process for monitoring and assessing the effectiveness of corrective actions. DOD stated that it had begun to take corrective actions on the program- and service-specific recommendations, and that it was seeking to improve CPC policies across the department, using the information from its study to help guide future actions. Although these appear to be positive steps, DOD in its response did not provide specific information on its corrective actions or how it was documenting recommendations or monitoring and assessing the effectiveness of corrective actions. Therefore, we could not assess to what extent DOD's actions will meet the intent of our recommendations.

DOD partially concurred with our recommendation pertaining to five other weapon systems identified in the study. DOD stated that its study team did not conduct a review of these weapon systems or have any insight into them in order to determine program-specific corrosion issues. Further, DOD stated that any recommendations flowing from the report with regard to these systems would be more appropriately labeled "best practices." Although DOD did not focus on these five systems, the study indicated that they were in a preproduction acquisition status where there was potential opportunity to incorporate CPC lessons learned from the F-35 and F-22. Therefore, we continue to believe that DOD should take steps to ensure that applicable lessons learned are identified and incorporated into the acquisition programs of these five systems in order to avoid future costs due to corrosion.

We are sending copies of this report to the appropriate congressional committees. We are also sending copies to the Secretary of Defense; the Deputy Secretary of Defense; the Under Secretary of Defense for Acquisition, Technology and Logistics; the Secretaries of the Army, Navy, and Air Force; and the Commandant of the Marine Corps. This report will also be available at no charge on our Web site at http://www.gao.gov.

Should you or your staffs have any questions concerning this report, please contact me at (202) 512-8246 or edwardsj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report were Tom Gosling, Assistant Director; Susannah Hawthorne; and Janine Prybyla.



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The Honorable John McCain
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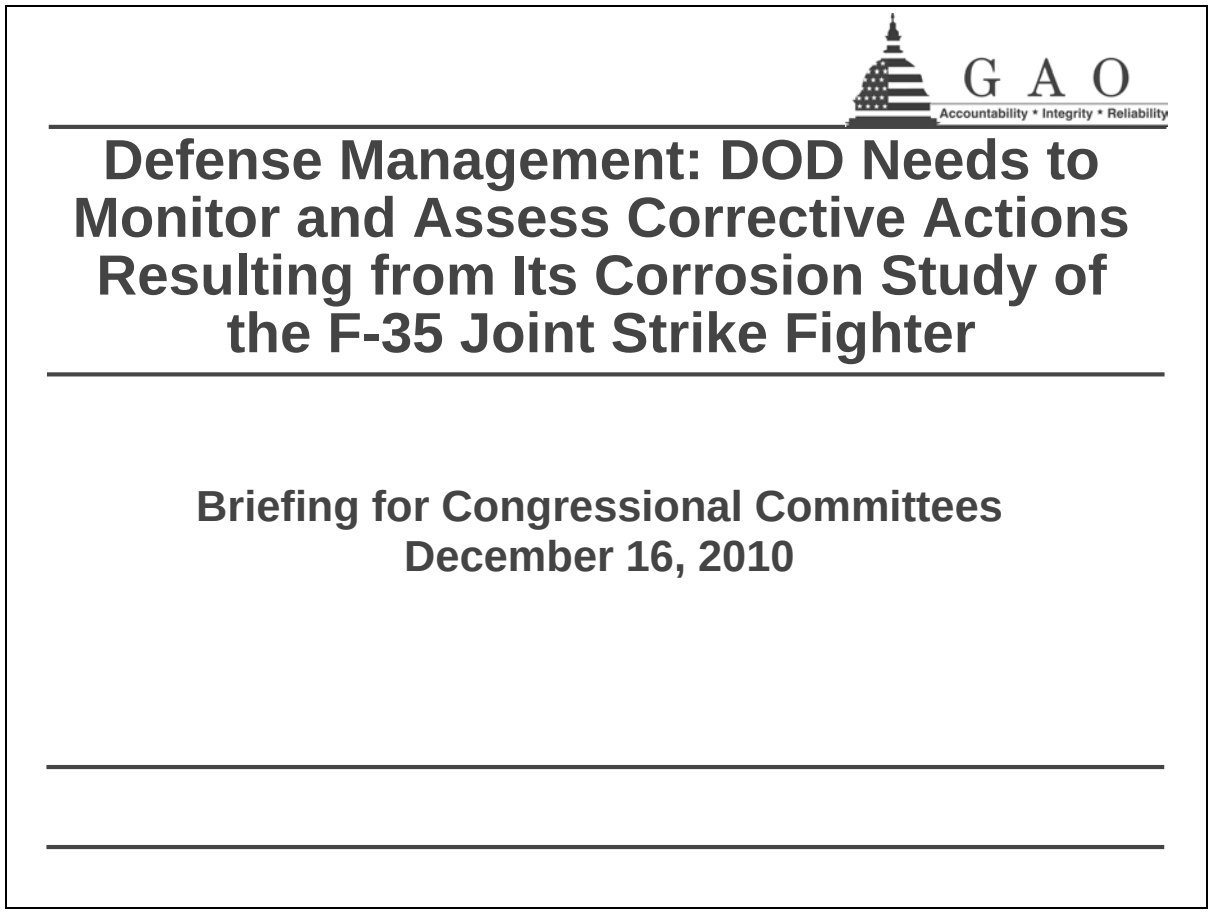
Enclosure I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Defense Management: DOD Needs to Monitor and Assess Corrective Actions Resulting from Its Corrosion Study of the F-35 Joint Strike Fighter
Briefing for Congressional Committees
December 16, 2010

Contents

Introduction

Corrosion is costly and affects readiness and safety; DOD and services have taken steps to prevent and control corrosion

- Corrosion can have negative effects on military equipment in terms of cost, readiness, and safety.
  - The Department of Defense (DOD) estimated in July 2010 that corrosion of military equipment costs the military services over $21 billion a year.
  - Corrosion affects military readiness by taking critical systems out of action, and has also affected safety, resulting in fatal accidents due to the degradation of equipment.
- Corrosion is defined as the unintended destruction or deterioration of a material due to interaction with the environment. It includes such varied forms as rusting; pitting; galvanic reaction; calcium or other mineral buildup; degradation due to ultraviolet light exposure; and mold, mildew, or other organic decay.
- Within the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (OUSD (AT&L)), the Office of Corrosion Policy and Oversight is responsible for the prevention and mitigation of corrosion of military equipment. Each military department has designated a corrosion executive who serves as the principal point of contact to the Office of Corrosion Policy and Oversight and coordinates corrosion prevention and control (CPC) efforts.
- DOD seeks to minimize the impact of corrosion on weapon systems and has established key elements of CPC planning for this purpose. For instance, weapon system program offices are encouraged to develop a CPC plan and establish a corrosion prevention advisory team to help mitigate potential corrosion problems.

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Introduction

F-22 and F-35 will be the backbone of DOD's tactical fleet; efforts to address corrosion problems with the F-22 are under way

- The F-22 Raptor and the F-35 Joint Strike Fighter will be the backbone of DOD's tactical fighter fleet for decades to come. These two systems are referred to as fifth-generation fighters and possess capabilities, such as low observable characteristics (stealth), data fusion from multiple sources, and advanced electronics and communications systems.
  - The F-22 is nearing the end of production at 187 aircraft and is being procured by the U.S. Air Force.
  - The F-35 is the largest acquisition program in the history of DOD and is a joint and international program that includes three U.S. military services and eight international partners. The F-35 is in development and has begun low-rate production. Production is expected to continue for 20 or more years and produce 3,000 or more aircraft.
- Efforts are under way to address corrosion problems with the F-22. Corrosion of the aluminum skin panels on the F-22 was first observed in spring 2005, less than 6 months after the Air Force first introduced the aircraft to a severe environment. By October 2007, a total of 534 instances of corrosion were documented, and corrosion in the substructure was becoming prevalent. For corrosion damage identified to date, the government is paying $228 million to make F-22 corrosion-related repairs and retrofits through 2016.

Introduction

House Report 111-166 directed DOD to evaluate the F-35 program

- In House Report 111-166 to accompany the House bill (H.R. 2647) that later became the National Defense Authorization Act for Fiscal Year 2010, the House Armed Services Committee:
  - expressed concerns that the lessons learned regarding the prevention and management of corrosion in the F-22 had not been fully applied to the development and acquisition of the F-35;
  - directed the Director of Corrosion Policy and Oversight to evaluate the F-35 program and to submit a report to the defense committees within 180 days after the act was enacted; and
  - stated that the report should include, but not be limited to, information obtained from floor inspections and examination of program documentation, implications for existing and future weapons systems based on the findings of the F-35, and any and all manufacturing and engineering processes.
- The House Report also directed GAO to provide an assessment of the completeness of DOD's evaluation and submit a report to the defense committees within 60 days after the date on which DOD submits its evaluation.
- DOD submitted its final report, entitled *Corrosion Evaluation of the F-22 Raptor and F-35 Lightning II Joint Strike Fighter,* on September 30, 2010.[1]

[1]The report is dated September 20, 2010.

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Objectives

In assessing the completeness of DOD's corrosion study, our objectives were to determine the extent to which the study:

- assessed the incorporation of lessons learned from the F-22's corrosion problems into the F-35's CPC program,
- identified implications for other current and future weapon systems' CPC programs, and
- was consistent with generally accepted research standards that define a sound and complete study with regard to design, execution, and presentation.

Scope and Methodology

- To conduct our work, we took the following steps:
  - Reviewed DOD's September 2010 report and documentation that the DOD study team collected to support its evaluation of the F-35 program, and identified F-22 lessons learned and implications for other weapon systems.
  - Interviewed members of the DOD study team to obtain their views on key aspects of the evaluation, including its objectives, scope, and methodology; findings; conclusions; and any limitations that may have impeded their ability to conduct a comprehensive review.
  - Identified generally accepted research standards, based on prior GAO work, that define a sound and complete study,[2] determined which of these standards were relevant to DOD's corrosion study, and compared characteristics of DOD's study against those standards.
  - Obtained the perspectives of the Air Force and the Navy corrosion executives and F-35 and F-22 program offices on DOD's study, including its approach, methodology, and findings.

[2]GAO identified frequently occurring, generally accepted research standards that are relevant for defense studies and define a quality or sound and complete study as part of its 2006 review of the adequacy and completeness of a DOD study. The standards drew from several sources, including prior GAO work and external organizations such as the RAND Corporation. See GAO, *Defense Transportation: Study Limitations Raise Questions about the Adequacy and Completeness of the Mobility Capabilities Study and Report*, GAO-06-938 (Washington, D.C.: Sept. 20, 2006).

Scope and Methodology

- We conducted this performance audit from July 2010 through December 2010 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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Summary of Findings

- **Objective 1:** DOD's corrosion study identifies several areas where the F-35 program has incorporated lessons learned from the F-22's corrosion problems, compares and contrasts the two aircraft programs, and discusses potential future corrosion issues for the F-35.
- **Objective 2:** The corrosion study addresses implications for other weapon systems' CPC programs. For example, it identifies key practices on which effective corrosion prevention and control for any weapon system depend, names specific weapon system programs that could benefit from F-22 and F-35 lessons learned, and cites commonly noted corrosion prevention and control issues.
- **Objective 3:** The corrosion study was generally consistent with research standards that define a sound and complete study with regard to design, execution, and presentation. The study team made recommendations in exit briefings to the program offices and the report contains numerous statements suggesting corrective actions may be needed at the service and DOD levels, but no formal recommendations were made in the report. Thus, it may be difficult for DOD and Congress to monitor and assess corrective actions taken in response to the study's findings.
- **Recommendation for Executive Action**: We are making recommendations aimed at ensuring that the program offices, services, and DOD take sufficient corrective actions in response to the findings in the corrosion study. DOD concurred with three recommendations and partially concurred with one.

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Objective 1: F-22 Lessons Learned

Study documents several steps taken by F-35 program to control and prevent corrosion based on F-22's problems

- The DOD corrosion study identifies several areas where the F-35 program has incorporated lessons learned from the F-22's corrosion problems; examples follow.
  - The F-35 program is mitigating corrosion risk associated with conductive gap filler[3] and paint by using a gap filler that is less galvanically dissimilar from aluminum, an alternative to the conductive paint, a design with fewer seams that require gap filler, and more representative verification and qualification testing. Many of the F-22's corrosion problems were linked to problems with gap filler materials and paint.
  - The F-35 program made organizational changes that integrated the personnel working within the corrosion materials and processes functional area and the low-observable (i.e., stealth) functional area. In contrast, personnel working within these areas for the F-22 program were "stove-piped."
  - The F-35 drainage design is significantly improved with more, adequately sized drain holes. Drain holes in the F-22 were found to be too small to enable good water drainage.

[3]Gap filler is the sealant between exterior panels that is required by low-observable aircraft.

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Objective 1: F-22 Lessons Learned

Study compares and contrasts the two programs

- The DOD corrosion study also compares and contrasts the two programs with respect to corrosion prevention and control.
- According to the study, the F-22 and F-35 programs were similar in that they both followed a performance-based acquisition approach. This approach gives the contractor the flexibility to design the aircraft to meet high-level requirements set by the government. However, neither aircraft had a corrosion prevention user requirement[4] that would drive CPC as a design requirement. Further, the program offices for both aircraft only required "corrosion resistance" within the system specifications, a poorly defined and nonspecific term that is difficult to ensure incorporation into aircraft components and to verify.
- While not necessarily due to lessons learned from the F-22 program, the study identifies several important differences between the programs. For example, the F-35 program:
  - has several technical performance metrics, such as sortie generation rate, that are indirectly driving actions to improve supportability, while the F-22 program did not;
  - has a more robust corrosion design largely due to inclusion of more stringent Navy corrosion qualification tests;
  - has a longer service life requirement (30 years vs. 20 years for the F-22); and
  - has a Corrosion Prevention Advisory Board where corrosion issues are discussed in detail and both the contractor and the government display a willingness to address these issues.

[4]User requirements are top-level elements that are required to be included in an aircraft's design and are specified in the F-35's Capabilities Development Document and the F-22's Operational Requirements Document.

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Objective 1: F-22 Lessons Learned

Study discusses potential future corrosion issues for the F-35

- While the corrosion study states that the F-35 program incorporated several lessons learned from the F-22's corrosion problems, the study also discusses potential future corrosion issues for the F-35 based on F-22 lessons learned and how these issues could be mitigated by making changes to the current plans for the F-35; examples follow.
  - Environmental and occupational health concerns drove the initial use of a nonchromated primer[5] on the F-22 that did not provide corrosion protection, and the program later switched to a chromated primer. The F-35 has also chosen to use a nonchromated primer that has never been tested on an aircraft in a corrosive operating environment.
  - No operational-level test for corrosion was conducted on the F-22 prior to initial operating capability, and none are currently planned for the F-35.
  - The length of the F-22 full-scale climatic test was cut in half, and the program office for the F-35 is currently considering reducing its full-scale climatic test.
- The corrosion study concluded that, if the F-22 program had accomplished testing earlier in the program, many of the corrosion problems could have been addressed at greatly reduced cost and the associated readiness issues avoided. If the F-35 conducts tests that are planned and conducted properly and in full, these tests could reveal many corrosion-susceptible areas on the aircraft.

[5]A nonchromated primer does not contain hexavalent chromium (Cr+6).

Objective 2: Implications for Other Systems

Study addresses various implications

- DOD's corrosion study addresses various implications for other existing and future weapon systems. For example, it addresses key practices on which effective CPC for any weapon system depend, names specific weapon system programs that could benefit from F-22 and F-35 lessons learned, and cites commonly noted CPC issues.
- The study also includes more generic factors that could potentially contribute to corrosion in other weapon systems. These factors are related to current acquisition practices, the application of lessons learned from legacy systems, lack of Air Force expertise with corrosion, and lack of Navy expertise with low-observable technology.
- The study team based these implications for other weapon systems on its review of the F-22 and F-35, briefings on other weapon system programs at the Naval Air Systems Command, and assistance the DOD Corrosion Policy and Oversight Office has given programs during acquisition system reviews.
- The Air Force and Navy corrosion executives stated that they agreed with study findings pertaining to their services and were planning to take corrective actions.

Objective 2: Implications for Other Systems

Study identifies key CPC practices and names specific systems that could benefit from lessons learned

- DOD's corrosion study identifies key practices on which effective CPC for any weapon system depend. These practices include:
  - independent expert evaluation and advice;
  - clear and traceable "flow down" of CPC requirements to aircraft components;
  - design guidelines and trade-offs that balance competing requirements;
  - adequate verification and validation through testing that is operationally representative; and
  - early operational evaluation in corrosive environments.
- The study also names a number of new weapon systems that could benefit from CPC lessons learned from both the F-22 and the F-35. These systems include the Expeditionary Fighting Vehicle, CH-53K helicopter, Joint High Speed Vessel, Broad Area Maritime Surveillance Unmanned Aircraft System, and the Joint Light Tactical Vehicle. The study identifies these systems as candidates for incorporating lessons learned due to their preproduction acquisition status.

Objective 2: Implications for Other Systems
Study cites common CPC issues

- DOD's study also cites several corrosion CPC issues that are common to weapon system programs.
  - CPC is not listed within user requirements documents.
  - CPC is not integrated into system engineering processes.
  - The program office lacks an effective corrosion prevention advisory team.
  - The program office lacks a strong CPC focus.
  - Life-cycle costs accounting for the impact of corrosion are not considered during program decision making.

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Objective 2: Implications for Other Systems

Air Force and Navy corrosion executives stated they were taking corrective actions

- Air Force and Navy corrosion executives stated they agreed with the findings identified in DOD's study that pertain to their services and briefed the Principal Deputy Under Secretary of Defense (AT&L) on corrective actions being taken to address these issues; examples follow.
  - The Air Force is
    - strengthening the charter of the Air Force Corrosion Prevention Advisory Board[6] to, among other things, include other stakeholders and
    - forming integrated product teams within the Advisory Board to address corrosion-related weaknesses in the areas identified by DOD's study.
  - The Navy is
    - developing a corrosion strategic plan (scheduled completion in fiscal year 2011) and
    - drafting a Navy instruction with corrosion policy, protocols, and timelines (scheduled completion in fiscal year 2011).
- As these actions have not yet been completed, it is not clear the extent to which they will address and correct the corrosion issues identified in DOD's study.

[6]This Advisory Board oversees and coordinates efforts throughout the Air Force to prevent and mitigate corrosion of military equipment.

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Objective 3: Design, Execution, and Presentation

Study was generally consistent with research standards

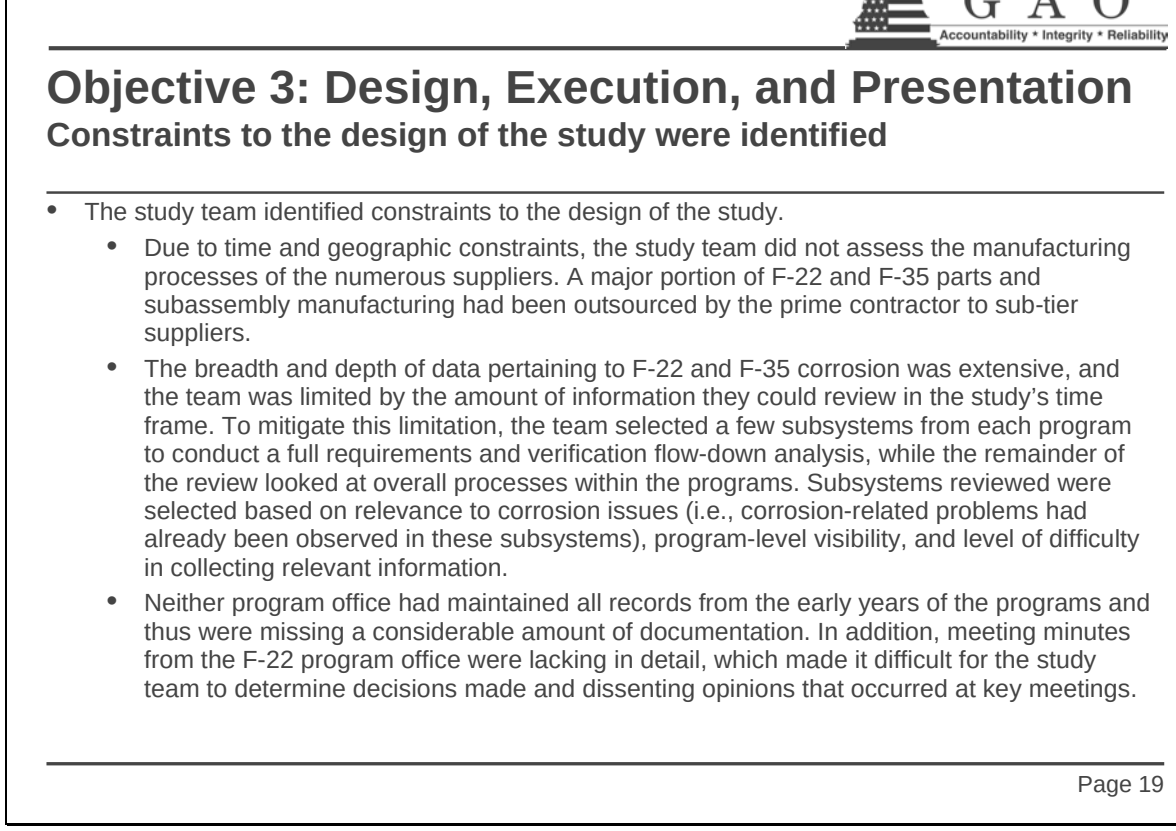
- The corrosion study was generally consistent with research standards that define a sound and complete study with regard to design, execution, and presentation.
- Generally accepted research standards include the following elements:[7]
  - *Design* standard: The study is well designed. The study's plan, scope, and objectives follow guidance, and constraints are explicitly identified.
  - *Execution* standard: The study is well executed. The methodology is successfully executed, and data are collected to support the analyses.
  - *Presentation* standard: Presentation of results is timely, accurate, concise, and relevant to the client and stakeholders. The presentation of the results supports the study's findings, recommendations are supported by analyses, and the participants and stakeholders are informed of the study results and recommendations.

[7]Each of the three standards has a number of supporting elements. However, not all of these are applicable to every study. For example, some elements apply to scenarios, threats, modeling, and assumptions and may be relevant to studies that make future projections or estimates. Similarly, some elements apply to the verification and validation of data and may be relevant to studies that rely on quantitative analyses as a basis for findings.

Objective 3: Design, Execution, and Presentation

Study was well designed and consistent with guidance

- The corrosion study generally met the design standard. The plan, scope, and objectives were consistent with congressional direction and departmental guidance implementing that direction.
  - The Director of Corrosion Policy and Oversight established a team of government personnel and contractors to conduct the study. Team members collectively had expertise and experience with weapon system program management and corrosion.
  - The study team used the language in the House Report as its starting point to develop its evaluation design. An October 19, 2009, memorandum signed by the USD (AT&L) provided further guidance.
  - The evaluation design was multifaceted and included site visits, collection and analysis of program documentation, interviews with program officials, reviews of engineering and manufacturing processes, and consultation with technical experts. The study team identified relevant criteria for its study, including lessons learned from the F-22 program and systems engineering best practices.
  - A comprehensive study plan documenting all steps in the evaluation design was not developed. However, elements of the design were captured in various planning documents, and the study team briefed the affected parties on the evaluation design, including the weapon system program offices.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Objective 3: Design, Execution, and Presentation
Constraints to the design of the study were identified
The study team identified constraints to the design of the study.
Due to time and geographic constraints, the study team did not assess the manufacturing processes of the numerous suppliers. A major portion of F-22 and F-35 parts and subassembly manufacturing had been outsourced by the prime contractor to sub-tier suppliers.
The breadth and depth of data pertaining to F-22 and F-35 corrosion was extensive, and the team was limited by the amount of information they could review in the study's time frame. To mitigate this limitation, the team selected a few subsystems from each program to conduct a full requirements and verification flow-down analysis, while the remainder of the review looked at overall processes within the programs. Subsystems reviewed were selected based on relevance to corrosion issues (i.e., corrosion-related problems had already been observed in these subsystems), program-level visibility, and level of difficulty in collecting relevant information.
Neither program office had maintained all records from the early years of the programs and thus were missing a considerable amount of documentation. In addition, meeting minutes from the F-22 program office were lacking in detail, which made it difficult for the study team to determine decisions made and dissenting opinions that occurred at key meetings.
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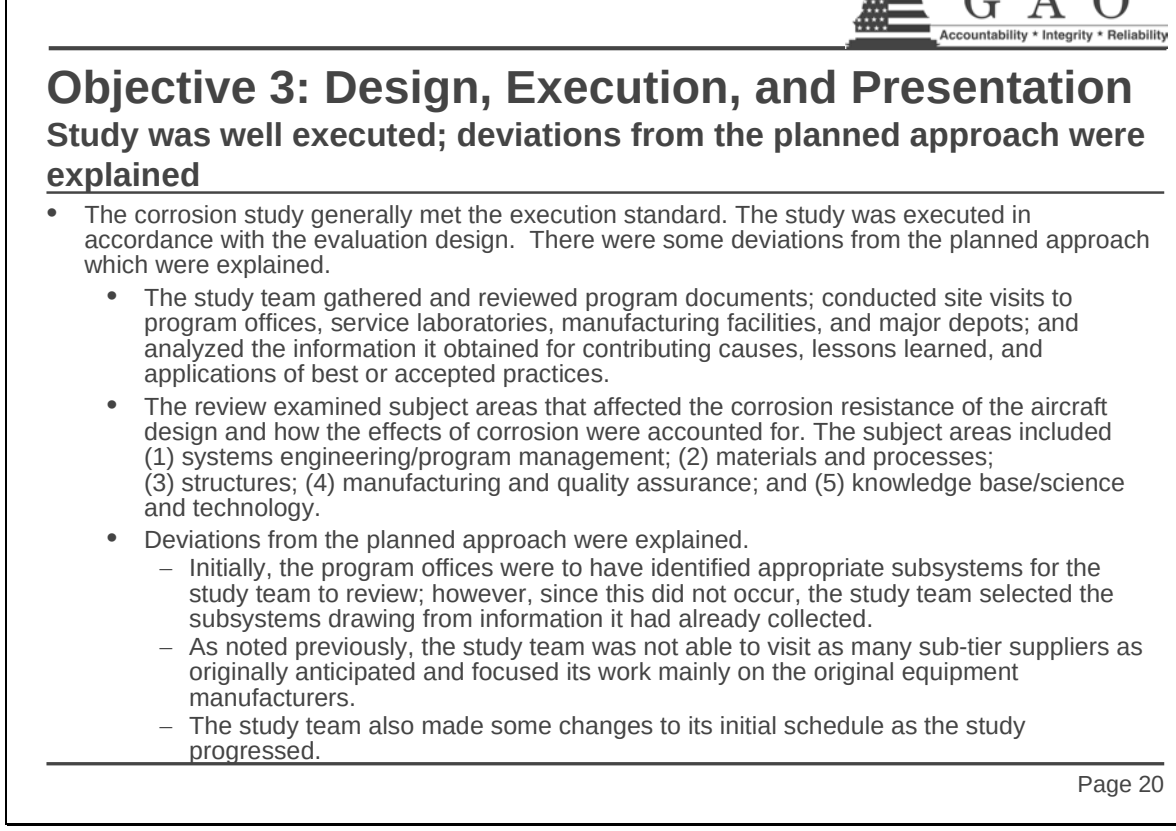
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Objective 3: Design, Execution, and Presentation
Study was well executed; deviations from the planned approach were explained
The corrosion study generally met the execution standard. The study was executed in accordance with the evaluation design. There were some deviations from the planned approach which were explained.
The study team gathered and reviewed program documents; conducted site visits to program offices, service laboratories, manufacturing facilities, and major depots; and analyzed the information it obtained for contributing causes, lessons learned, and applications of best or accepted practices.
The review examined subject areas that affected the corrosion resistance of the aircraft design and how the effects of corrosion were accounted for. The subject areas included (1) systems engineering/program management; (2) materials and processes; (3) structures; (4) manufacturing and quality assurance; and (5) knowledge base/science and technology.
Deviations from the planned approach were explained.
Initially, the program offices were to have identified appropriate subsystems for the study team to review; however, since this did not occur, the study team selected the subsystems drawing from information it had already collected.
As noted previously, the study team was not able to visit as many sub-tier suppliers as originally anticipated and focused its work mainly on the original equipment manufacturers.
The study team also made some changes to its initial schedule as the study progressed.
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Objective 3: Design, Execution, and Presentation

Study presents results that support its findings

- The corrosion study generally met the presentation standard.
  - Our review of documents collected by the study team and our discussions with team members showed that the presentation of results in the report supports findings developed in the evaluation.
  - In addition, we found the report was consistent with this standard in that it addressed the study's objectives, cited documentary support for key points, and contained conclusions that are supported by analyses.
  - While the study team identified constraints to the design of the study and was able to explain deviations from its planned approach, not all constraints and deviations were explicitly discussed in the report.
  - The F-22 and F-35 program offices, as well as the Air Force and the Navy, were given an opportunity to comment on a draft of the report. The comments were addressed by the study team, and any changes they deemed necessary were incorporated into the final report. Further, all of the comments and the team's responses were incorporated into an appendix in the final report.
  - While the program offices disagreed with some of the specific findings regarding their programs, both program offices and the Air Force and Navy corrosion executives agreed with the overall approach and findings of the study.

Objective 3: Design, Execution, and Presentation

Recommendations are not documented in DOD's study

- The findings and conclusions of DOD's corrosion study imply that corrective actions are needed, but the report does not include formal recommendations.
  - The study team provided recommendations to both program offices during their exit briefings. In addition, throughout the report, recommended courses of action for the program offices are implied; examples follow.
    - "The [F-22] program should heed the lessons they could have learned from their early corrosion experience as the fixes are implemented and tested."
    - "With appropriate mitigation planning and activities, the F-35 can address the remaining corrosion risks before they are realized. This will likely involve additional full scale and component-level testing, changes in design, and trade studies to address the long term cost and readiness implications of design choices."
  - Likewise, the report contains numerous statements implying that corrective actions are needed at the service and DOD levels. As noted previously, the Air Force and Navy corrosion executives have briefed DOD on actions they are taking in response to the corrosion study.
- Officials said they considered but did not make formal recommendations in the report because doing so likely would have increased the time for internal report coordination and concurrence.

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Objective 3: Design, Execution, and Presentation

Lack of formal recommendations could hamper follow-up and accountability

- In the absence of documented formal recommendations, it may be difficult for DOD and Congress to monitor and assess corrective actions taken in response to the study's findings.
- One element of the presentation standard states that recommendations arising from a research study should be supported by analyses. While this standard does not require researchers to make recommendations, a high-quality study thoroughly explores the implications of its findings. Further, recommending a course of action is a highly accountable step for researchers.[8]
- In addition, policymakers and program managers should implement sound internal controls to improve accountability and minimize operational problems. More specifically, internal control monitoring should assess the quality of performance over time and ensure the findings and recommendations of audits and other reviews are promptly resolved.[9]

[8]RAND Corporation, *RAND Standards for High-Quality Research and Analysis* (Santa Monica, Calif.: January 2010). These standards were part of GAO's 2006 review of research literature and DOD guidance that identified frequently occurring, generally accepted research standards that are relevant for defense studies and define a quality or sound and complete study. See GAO-06-938.

[9]GAO, *Internal Control: Standards for Internal Control in the Federal Government,* GAO/AIMD-00-21.3.1 (Washington, D.C.: November 1999).

Conclusions

- Based on our review, we believe DOD's evaluation of the F-35 Joint Strike Fighter corrosion prevention and control program is reasonably complete given the time limitations and other constraints.
- The study highlights important lessons learned from the F-22's corrosion problems and identifies ongoing corrosion concerns for both the F-22 and F-35, as well as implications for other current and future weapon systems, but the lack of formal recommendations flowing from the study may hinder the implementation of corrective actions needed to address these ongoing concerns and implications.
- The study names five other weapon systems that could potentially benefit from F-35 and F-22 corrosion lessons learned, but it is not clear from the study to what extent the lessons have actually been incorporated into these systems' CPC programs. Given the preproduction status of the five systems, actions taken in a timely manner to incorporate the lessons learned could have a positive impact on preventing future corrosion.
- Documenting, monitoring, and assessing corrective actions at the program offices, the services, and DOD-wide would help DOD to minimize the effects of corrosion on military equipment.

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Recommendations for Executive Action

- To ensure sufficient follow-up to DOD's corrosion study, we are recommending that the Secretary of Defense direct the USD (AT&L) to take the following four actions:
  - Document program-specific recommendations flowing from the corrosion study with regard to the F-35 and F-22 and establish a process for monitoring and assessing the effectiveness of these programs' corrective actions.
  - Document program-specific recommendations flowing from the corrosion study with regard to the other weapon systems identified—specifically, the Expeditionary Fighting Vehicle, CH-53K helicopter, Joint High Speed Vessel, Broad Area Maritime Surveillance Unmanned Aircraft System, and the Joint Light Tactical Vehicle—and establish a process for monitoring and assessing the effectiveness of the CPC programs for these systems.
  - Document Air Force- and Navy-specific recommendations flowing from the corrosion study and establish a process for monitoring and assessing the effectiveness of these services' corrective actions.
  - Document DOD-wide recommendations flowing from the corrosion study, implement any needed changes in policies and practices to improve CPC in new systems, and establish a process for monitoring and assessing the effectiveness of the department's corrective actions.

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Agency Comments and Our Evaluation

- In its written comments, DOD concurred with three recommendations and partially concurred with one.
- DOD concurred that it should document F-22 and F-35 program-specific, service-specific, and DOD-wide recommendations flowing from the corrosion study and that it should monitor and assess the effectiveness of corrective actions. DOD stated that it had begun to take corrective actions. Because DOD did not provide specific information on these corrective actions or how it would implement our recommendations, we could not assess to what extent DOD's actions will meet the intent of our recommendations.
- DOD partially concurred that it should document recommendations pertaining to the five other identified systems and that it should monitor and assess the effectiveness of corrective actions. DOD stated that the study team did not review these systems or have insight into them in order to determine program-specific corrosion issues. However, as noted earlier, the study identifies these systems as candidates for incorporating lessons learned due to their preproduction acquisition status. Therefore, we continue to believe DOD should take steps to ensure that applicable lessons learned from the F-35 and F-22 are identified and incorporated into the acquisition programs of these five systems in order to avoid future costs due to corrosion.

Related GAO Products

- *Defense Management: DOD Has a Rigorous Process to Select Corrosion Prevention Projects, but Would Benefit from Clearer Guidance and Validation of Returns on Investments.* GAO-11-84. Washington, D.C.: December 8, 2010.
- *Defense Management: Observations on Department of Defense and Military Service Fiscal Year 2011 Requirements for Corrosion Prevention and Control.* GAO-10-608R. Washington, D.C.: April 15, 2010.
- *Defense Management: Observations on the Department of Defense's Fiscal Year 2011 Budget Request for Corrosion Prevention and Control.* GAO-10-607R. Washington, D.C.: April 15, 2010.
- *Joint Strike Fighter: Additional Costs and Delays Risk Not Meeting Warfighter Requirements on Time.* GAO-10-382. Washington, D.C.: March 19, 2010.
- *Defense Management: Observations on DOD's Analysis of Options for Improving Corrosion Prevention and Control through Earlier Planning in the Requirements and Acquisition Processes.* GAO-09-694R. Washington, D.C.: May 29, 2009.
- *Joint Strike Fighter: Accelerating Procurement before Completing Development Increases the Government's Financial Risk.* GAO-09-303. Washington, D.C.: March 12, 2009.
- *Defense Management: High-Level Leadership Commitment and Actions Are Needed to Address Corrosion Issues.* GAO-07-618. Washington, D.C.: April 30, 2007.

Enclosure II

Comments from the Department of Defense

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION, TECHNOLOGY AND LOGISTICS

Mr. Jack E. Edwards
Driector, Defense Capabilities and Management
U.S. Government Accountability Office
441 G Street, N. W.
Washington, DC 20548

DEC 9 2010

Dear Mr. Edwards:

This is the Department of Defense (DoD) response to the GAO Draft Report, GAO-11-171R, "DEFENSE MANAGEMENT: DOD Needs to Monitor and Assess Corrective Actions Resulting from Its Corrosion Study of the F-35 Joint Strike Fighter," dated November, 2010 (GAO Code 351517). Attached is DoD's proposed response to subject report.

Sincerely,

Daniel J. Dunmire
Director,
DoD Corrosion Policy and Oversight

Enclosures:
As stated

GAO DRAFT REPORT DATED NOVEMBER 15, 2010
GAO-11-171R (GAO CODE 351517)

"DEFENSE MANAGEMENT: DOD NEEDS TO MONITOR AND ASSESS CORRECTIVE ACTIONS RESULTING FROM ITS CORROSION STUDY OF THE F-35 JOINT STRIKE FIGHTER"

DEPARTMENT OF DEFENSE COMMENTS TO GAO RECOMMENDATION

RECOMMENDATION 1: The GAO recommends that the Secretary of Defense direct the Under Secretary of Defense, Acquisition, Technology and Logistics to document program-specific recommendations flowing from the corrosion study with regard to the F-35 and F-22 and establish a process for monitoring and assessing the effectiveness of these programs' corrective actions (See page 25/GAO Draft Report).

DoD RESPONSE: Concur. The DoD has already begun taking action on the F-35 and F-22 program-specific findings of the study.

RECOMMENDATION 2: The GAO recommends that the Secretary of Defense direct the Under Secretary of Defense, Acquisition, Technology and Logistics to document program-specific recommendations flowing from the corrosion study with regard to the other weapon systems identified – specifically, the Expeditionary Fighting Vehicle, CH-53K helicopter, Joint High Speed Vessel, Broad Area Maritime Surveillance Unmanned Aircraft System, and the Joint Light Tactical Vehicle – and establish a process for monitoring and assessing the effectiveness of the CPC programs for these systems (See page 25/GAO Draft Report).

DoD RESPONSE: Partially concur. Recommendations flowing from the corrosion study for other weapon systems identified in the report are general in nature and not specific to a program. These weapon systems were identified due to the phase of acquisition they are in and a general understanding of the materials used. Recommendations flowing from the report on these systems would be more appropriately labeled top level "best practices" that apply to any system and are already stated at the end of the Executive Summary of the report. The evaluation team did not conduct a review of the other weapon systems or have any insight into those programs to determine any program specific corrosion issues.

RECOMMENDATION 3: The GAO recommends that the Secretary of Defense direct the Under Secretary of Defense, Acquisition, Technology and Logistics to

document Air Force- and Navy-specific recommendations flowing from the corrosion study and establish a process for monitoring and assessing the effectiveness of these services' corrective actions (See page 25/GAO Draft Report).

DoD RESPONSE: Concur. The DoD has already begun taking action on the Air Force- and Navy-specific findings of the study.

RECOMMENDATION 4: The GAO recommends that the Secretary of Defense direct the Under Secretary of Defense, Acquisition, Technology and Logistics to document DoD-wide recommendations flowing from the corrosion study, implement any needed changes in policies and practices to improve CPC in new systems, and establish a process for monitoring and assessing the effectiveness of the department's corrective actions (See page 25/GAO Draft Report).

DoD RESPONSE: Concur. The DoD corrosion program is seeking to improve the policies and practices for CPC across the department and will use the information from the report to help guide future actions.